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INFLUENCE OF PASSIVE SMOKING AND PARENTAL PHLEGM ON PNEUMONIA AND BRONCHITIS IN EARLY CHILDHOOD

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Summary The incidence of pneumonia and bronchitis has been studied in 2205 infants over the first five years of life. In the same period their parents' smoking habits and respiratory symptoms were recorded annually. The incidence of pneumonia and bronchitis in the first year of life was associated with parents' smoking habits; incidence was lowest where both parents were non-smokers, highest where both smoked, and lay between these two levels where only one parent smoked. Over the age of one year the association was not consistent. When parents' respiratory symptoms were also studied a close association was found with the incidence of pneumonia and bronchitis in the child; this was independent of parents' smoking habits and was an almost consistent finding throughout the first five years of life. In the first year of life exposure to cigarette smoke generated when parents smoked doubled the risk for the infant of an attack of pneumonia or bronchitis.

Introduction

INFANTS who inhale the tobacco smoke generated when their parents smoke at home may have a greater risk of chest illness than the infants of non-smoking parents. We have studied the influence of parental smoking and respiratory symptoms for effects on the incidence of pneumonia and bronchitis in their children during the first five years of life.

Methods

The data that form the basis of this paper are part of those collected during a longitudinal study of newborn infants and their families. The study was conducted in Harrow, a borough in north-west London, between 1963 and 1969 and involved all families living in six of the wards of the borough who had an infant born in the period July 1, 1963, to June 30, 1965. A total of 2365 families had newborn infants during this period, and, of these, 2205 (93%) were included in the study. The 6·8% excluded (i.e., 160 families) had either moved away from the area before they could be visited or refused to cooperate in the study (table I). The analysis that follows has been based upon the infants born to these families. After exclusions—for example, multiple births—2149 infants were eligible for study. Over the five years of follow-up losses inevitably occurred from the original population; these were small and are unlikely to have seriously biased the findings in the later years of follow-up.

Health visitors, who received special training, administered a questionary to the parents, when, as part of their routine duties, they visited the infant and mother at home within fourteen days of the delivery. At this visit a number of items were recorded, including birth-weight in pounds to the nearest pound below.

TABLE I—SURVEY POPULATION OVER THE FIVE YEARS OF FOLLOW-UP

No. of families with newborn infants born July 1, 1963, to June 30, 1965		No. of index infants at annual follow-up					
Total	Cooperated in survey	Initial visit	First	Second	Third	Fourth	Fifth
2365	2205	2149	2122	2109	2096	2097	2095

The health visitor also administered a questionary which included questions on respiratory symptoms and smoking habits. In this paper positive responses to the question "Do you usually bring up any phlegm from your chest first thing in the morning in the winter?" has been used as evidence for parental respiratory disability. To elicit smoking habits the questions were: "Do you smoke?" If answered "yes", the parent was classified as a present smoker. If answered "no" the parent was asked "Have you ever smoked?" If the answer was "yes", then the parent was classified as an ex-smoker. If answered "no" the parent was asked "Have you ever smoked as much as one cigarette a day for as long as a year?" An answer "no" classified parents as non-smokers. The present smokers were also asked "How many cigarettes are you smoking now?" The validity of the answers to these questions has already been established.[1]

The families were followed up annually for the next five years by postal questionaries. Each year parents were asked the following questions. For the infant, "Has he/she had in the past twelve months bronchitis? Pneumonia?" For the parents, "Did you usually bring up any phlegm from your chest first thing in the morning last winter?" Smoking habits were assessed using the question "Do you smoke?" If "yes", "How many are

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you smoking now?" The validity of answers to the question on infant bronchitis and pneumonia was assessed by checking, in a sample, the parents' account of such an illness with the family doctor's case-notes. The level of agreement was adequate and corresponded to that obtained in other studies where mothers were asked about their children's past health. The validity of the question on phlegm production in the parents has also been established.[2]

In the tables that follow, parents have been classified according to their smoking habits. Parents who at the initial visit had never smoked, and at the first and subsequent follow-ups had not taken up the habit, were classified at each follow-up as non-smokers. In the same way parents who at the initial visit were present smokers, and at the first and subsequent follow-ups did not give up the habit, were classified on each occasion as present smokers. There remained a further group of parents who had changed their habits. These included parents who at the initial visit were ex-smokers. They had been permanently allocated, irrespective of whether or not they took up smoking again, to the "ex-smokers or changed habits" group. In addition there is a further group of parents who were either non-smokers or smokers at the initial visit but who changed their habits during their follow-up. When this occurred they were reclassified permanently as members of the "ex-smokers or changed habits" group. In this way, for example, parents who were smokers at the initial and first and second follow-up visits would be classified as such at these follow-ups. If on the third follow-up they gave up smoking they would be moved to the "ex-smoker or changed habits" group for that and subsequent follow-up years. This method of classification ensures that at each follow-up year the group of "non-smoking" and "present smoking" parents contains parents with consistent smoking habits. The diminishing numbers at each follow-up in these two groups is a result of parents changing their habits and is balanced by the increasing numbers in the "ex-smokers and changed habits" group. The totals in these tables do not correspond to those in table I. This is accounted for by the exclusion of single-parent families and by absent data.

Results

The annual incidence per 100 children of pneumonia and bronchitis is given in table II by parents' smoking habit. Parents have been classified into one of four groups: (1) both parents non-smokers; (2) one parent smoker, the other non-smoker; (3) both parents smokers; (4) both parents ex-smokers, or one an ex-smoker, or parents who changed their smoking habits during the study. **The incidence of pneumonia and bronchitis in the infant shows a gradient by parents' smoking habit in the first year of life. Incidence is lowest in infants with both parents non-smokers, highest where both parents smoke, and lies between these values where one parent smokes. This is a statistically significant gradient ($p<0.0005$).** In subsequent years there is no such clear gradient.

TABLE II—PNEUMONIA AND BRONCHITIS BY PARENTS' SMOKING HABITS

Year of follow-up	Annual incidence per 100 children (absolute numbers in parentheses) of pneumonia and bronchitis				
	Both non-smokers	One smoker	Both smokers	Both ex-smokers or one ex-smoker or smoking habit changed	All
1	7·8 (372)	11·4 (552)	17·6 (478)	9·2 (675)	11·5 (2077)
2	8·1 (358)	9·3 (494)	8·9 (438)	7·4 (758)	8·3 (2048)
3	7·0 (342)	10·2 (460)	9·1 (396)	8·9 (834)	8·9 (2032)
4	8·4 (323)	8·3 (408)	9·0 (357)	8·4 (882)	8·5 (1970)
5	7·5 (318)	6·7 (374)	6·5 (340)	6·6 (956)	6·7 (1988)

In table III parents have been classified both by their smoking habits and by their response to the question "Did you usually bring up any phlegm from your chest first thing in the morning in the last winter?" In all categories except one, the incidence within a smoking category is higher among children where one or both parents have winter morning phlegm than in children whose parents are both free of this symptom. Some of the incidence-rates in the children—in particular those whose parents are both non-smokers and who have winter morning phlegm—are based upon small numbers and therefore may not be wholly reliable. On the other hand, the incidence-rates in children where neither parent has symptoms, whether they smoke or not, are based upon substantial numbers. **In them in the first year of life a consistent gradient is seen in the incidence of pneumonia and bronchitis in the children in relation to the parents' smoking habits.** The rates are lowest in children of non-smoking parents and highest where

TABLE III—PNEUMONIA AND BRONCHITIS IN THE FIRST FIVE YEARS OF LIFE BY PARENTS' SMOKING HABIT AND MORNING PHLEGM

Year of follow-up	Annual incidence per 100 children (absolute numbers in parentheses) of pneumonia and bronchitis									
	Both non-smokers		One smoker		Both smokers		Both ex-smokers or one ex-smoker or smoking habit changed		All	
	n	o/b	n	o/b	n	o/b	n	o/b	n	o/b
1	7·6 (343)	10·3 (29)	10·4 (424)	14·8 (128)	15·3 (339)	23·0 (139)	8·2 (546)	13·2 (129)	10·1 (1652)	16·7 (425)
2	8·1 (322)	8·3 (36)	7·1 (365)	15·5 (129)	8·7 (286)	9·2 (152)	6·5 (599)	10·7 (159)	7·4 (1572)	11·3 (476)
3	6·9 (305)	8·1 (37)	10·5 (353)	9·4 (107)	7·9 (242)	11·0 (154)	8·2 (661)	11·6 (173)	8·4 (1561)	10·6 (471)
4	8·0 (287)	11·1 (36)	7·5 (306)	10·8 (102)	7·6 (236)	11·6 (121)	8·2 (695)	9·1 (187)	7·9 (1524)	10·3 (446)
5	6·7 (285)	14·7 (34)	5·6 (267)	9·4 (107)	5·9 (208)	10·6 (132)	6·4 (737)	7·3 (219)	5·9 (1497)	9·1 (492)

n = neither with winter morning phlegm. o/b = one or both with winter morning phlegm.

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TABLE IV—PNEUMONIA AND BRONCHITIS BY NUMBER OF CIGARETTES SMOKED PER DAY BY PARENTS AND WINTER MORNING PHLEGM

Year of follow-up	Annual incidence per 100 children (absolute numbers in parentheses) of pneumonia and bronchitis							
	Both non-smokers		One or both smokers* of following number of cigarettes per day†:					
			1–14		15–24		25 and over	
	n	o/n	n	o/n	n	o/n	n	o/n
1	7·6 (343)	10·3 (29)	10·6 (269)	15·1 (53)	11·1 (171)	14·5 (76)	15·2 (323)	23·2 (138)
2	8·1 (322)	8·3 (36)	5·2 (231)	16·4 (55)	8·6 (151)	14·5 (62)	9·7 (269)	9·8 (164)
3	6·9 (305)	8·1 (37)	11·2 (206)	8·6 (58)	8·2 (146)	9·5 (42)	8·6 (243)	11·2 (161)
4	8·0 (287)	11·1 (36)	5·5 (163)	13·3 (45)	7·4 (136)	11·5 (52)	9·1 (243)	10·3 (126)
5	6·7 (285)	14·7 (34)	6·3 (144)	11·4 (44)	4·4 (113)	7·6 (53)	4·1 (218)	10·6 (142)

* Excluding parent pairs where one or both are ex-smokers or changed smoking habit.
† Includes tobacco and cigars expressed as cigarette equivalents (see Todd [7]).
n=neither with winter morning phlegm. o/n=one or both with winter morning phlegm.

both parents smoke. In children over the age of a year there is, however, no consistent gradient.

Exposure of the child to cigarette smoke may be more precisely estimated from the total daily cigarette consumption of both parents. In table IV the incidence of pneumonia and bronchitis is given for parent pairs smoking between them 1–14, 15–24, and 25 or more cigarettes per day, by the presence of winter morning phlegm. A clear gradient of increasing incidence is seen in the first year of life that is independent of the presence of winter morning phlegm and is of the same size as that in table III. In the second year and thereafter the pattern is not consistent and thus does not suggest an effect of exposure to tobacco smoke at ages over one year.

The gradients of incidence, particularly those attributable to passive smoking in the first year of life, could result from other factors which are known to influence respiratory disease in infancy—for example, social class and family size. These factors might account for the gradients if children of low social class or of large family size were concentrated in families where the parents smoked or had chest symptoms. That these factors did not explain the observed gradient can be seen in tables V and VI. In table V, the findings for social class III alone are examined. The patterns for pneumonia and bronchitis for all children in the first year of life persist. Similarly, in table VI, where the data are subdivided by the number of siblings in the family, the patterns for pneumonia and bronchitis persist within families of the same size. This makes it unlikely that either social class or family size can be responsible for these patterns of respiratory-disease incidence.

The infants of mothers who smoke in pregnancy are, on average, lighter than those of mothers who do not smoke.[3] As infants of low birth-weight are more likely to suffer respiratory illness than normal-weight infants, it is possible that the gradients in respiratory disease observed in the first year of life, and in particular the effects of passive smoking, may be due, indirectly, to maternal smoking during pregnancy. In this study, birth-weight, as expected, shows a gradient by parents' initial smoking habit, and to a lesser extent by winter morning phlegm. Thus parents who smoke have lighter infants than parents who do not smoke. The gradients in the incidence of pneumonia and bronchitis with parental smoking, and with winter morning phelgm, might therefore be partly attributable to differences in birth-weight. However, within different birth-weight categories the gradients for pneumonia and bronchitis with parents' smoking habits persist. Thus differences in birth-weight cannot account for the higher risk of pneumonia and bronchitis in the first year of life in children exposed to the cigarette smoke generated when their parents smoke at home.

TABLE V—PNEUMONIA AND BRONCHITIS IN THE FIRST YEAR BY PARENTS' SMOKING HABIT AND WINTER MORNING PHLEGM FOR SOCIAL CLASS III

Annual incidence per 100 children (absolute numbers in parentheses) of pneumonia and bronchitis										
Both non-smokers		One smoker		Both smokers		Both ex-smokers or one ex-smoker		All	
n	o/n	n	o/n	n	o/n	n	o/n	n	o/n
5·9 (171)	20·0 (15)	9·5 (263)	16·5 (79)	17·1 (217)	23·9 (88)	7·1 (294)	12·1 (66)	9·6 (945)	18·2 (248)

n=neither with winter morning phlegm. o/n=one or both with winter morning phlegm.

Discussion

An association between the respiratory symptoms

TABLE VI—PNEUMONIA AND BRONCHITIS IN THE FIRST YEAR BY NUMBER OF SIBLINGS AND BY PARENTS' SMOKING HABIT AND WINTER MORNING PHLEGM

No. of siblings	Annual incidence per 100 children (absolute numbers in parentheses) of pneumonia and bronchitis									
	Both non-smokers		One smoker		Both smokers		Both ex-smokers or one ex-smoker or smoking habit changed		All	
	n	o/n	n	o/n	n	o/n	n	o/n	n	o/n
0	3·9 (153)	14·3 (14)	5·1 (177)	6·3 (32)	13·3 (165)	12·7 (55)	5·8 (258)	6·4 (47)	6·9 (753)	9·5 (148)
1	8·1 (124)	0 (7)	12·0 (146)	12·0 (50)	13·6 (103)	34·1 (44)	9·6 (178)	17·5 (40)	10·9 (551)	19·9 (141)
2 and more	15·2 (66)	12·5 (8)	15·8 (101)	23·9 (46)	22·5 (71)	25·0 (40)	11·6 (110)	16·7 (42)	15·6 (348)	21·3 (136)

n=neither with winter morning phlegm. o/n=one or both with winter morning phlegm.

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in parents and in their school-age children was reported by Colley.[4] The present study demonstrates that this association is also found in younger children as early as the first year of life. The nature of this association, as Colley noted, is not clear. He concluded that it was unlikely to be an artefact due, for example, to parents with symptoms over-reporting symptoms in their children. In the present study a sample of parents had their account of respiratory illnesses in their children checked against the doctors' records. The close agreement between these two accounts makes it unlikely that over-reporting in families where parents have symptoms has occurred to any important extent.

The association could be a result of shared genetic susceptibility to respiratory disease between parents and children, to living in the same home environment, and to cross-infection within the family. Twin studies in adults have not been notably successful in assessing the genetic contribution to adult chronic respiratory disease, and no studies have yet been reported where this aspect was investigated in parents and their children. The contribution made by the other factors to this association can, at present, only be guessed at.

Passive smoking by the infant, after differences in birth-weight and parental respiratory symptoms have been allowed for, increases the risk to the infant of pneumonia and bronchitis in the first year of life. When both parents smoke, this risk is almost double that of infants with non-smoking parents. The findings confirm and extend those of Harlap and Davies.[5] These workers did not, however, have information on fathers' smoking habits, nor did they take account of parents' respiratory symptoms.

A picture has thus emerged of a serious risk to infants in the first year of life from exposure to their parents' cigarette smoke. In contrast, between one and five years of age, there does not appear to be any important effect of passive smoking in increasing the risk of pneumonia and bronchitis. Colley,[4] in 6–14-year-olds also found no association between passive smoking and the prevalence of chronic cough.

The estimates of children's exposure to cigarette smoke in this study are crude, being based either on whether parents were smokers or not, or on their total daily cigarette consumption. The smoke exposure of the children may have been overestimated, since parents—in particular the father—will smoke outside the home, or at times when the infant is not present. The effects on the child may thus have resulted from exposure to levels of cigarette smoke less than those suggested by our study.

The evidence from this study, taken with that of Harlap and Davies,[5] **provides convincing reasons for warning parents who smoke of the risks this entails for their children both from the direct effect of their cigarette smoke and from the presence of their respiratory symptoms. Attacks of pneumonia and bronchitis, particularly in the first year of life, can still result in infant death despite prompt and vigorous treatment. In those that survive such illnesses and recover clinically, the evidence points to some damage to the respiratory tract as indicated by an increased prevalence of chest symptoms and deficits in ventilatory function found in later childhood.**[6–8] The longer-term consequences of such childhood illnesses have been underlined by the findings in a cohort of infants followed to the age of 20.[9] At this age the prevalence of chronic cough, after allowing for current smoking habits, social class of father, and air-pollution exposure, was higher in those with a documented history of a chest illness under the age of 2 years than in those without this history. If, by the age of 20, such long-term effects are found, these could persist into middle and late adult life and contribute to the evolution of chronic respiratory disease.

Opportunities for the prevention of serious respiratory disease in infancy and childhood are few. If parents who smoke give up the habit they can reasonably expect to lose, or at least experience an improvement in, their respiratory symptoms. This might well result in reduction of respiratory illnesses in their children. At the same time the absence of cigarette smoke in the home could be expected to diminish the risk of attacks of pneumonia and bronchitis in their children during the first year of life.

This study was conducted jointly with the Health, Welfare, and Children's Department of the London Borough of Harrow, and we would particularly like to thank the Superintendent Health Visitors and their staff, the Senior Administrative Assistant in the Personnel Health Section and his staff, and others who took part for their help and cooperation in this study. Our thanks go to the fieldworkers from the Department of Community Medicine for the maintenance of the records and for their diligence in carrying out the fieldwork during the five years of follow-up. We are also grateful to the statistical assistants of the department for carrying out the analysis of the data.

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REFERENCES

1. Holland, W. W., Kasap, H. S., Colley, J. R. T., Cormack, W. *Br. J. prev. soc. Med.* 1969, 2, 77.
2. Krueger, D. R., Rogot, E., Blackwelder, W. C., Reid, D. D. *J. chron. Dis.* 1970, 23, 411.
3. Butler, N. R., Alberman, E. D. (editors). Perinatal Problems. Edinburgh, 1969.
4. Colley, J. R. T. *Br. med. J.* 1974, ii, 201.
5. Harlap, S., Davies, A. M. *Lancet*, 1974, i, 529.
6. Holland, W. W., Halil, T., Bennett, A. E., Elliott, A. *Br. med. J.* 1969, ii, 205.
7. Colley, J. R. T., Reid, D. D. *ibid.* 1970, ii, 213.
8. Bland, J. M., Holland, W. W., Elliott, A. *Revue Physio-path. resp.* (in the press).
9. Colley, J. R. T., Douglas, J. W. B., Reid, D. D. *Br. med. J.* 1973, iii, 195.
10. Todd, G. F. Statistics of Smoking in the U.K. London, 1972.

"The atomic physicists were as clever, as modest, as self-seeking, as mean, as argumentative and just as concerned for humanity as the microbe hunters. The physicists worked to produce a weapon of war, but there is no real evidence that the nationalistic arguments which convinced them that their efforts were right and just were any different from those that so affected Koch and Pasteur half a century earlier; and the intellectual challenge was just as great, and grappling with it just as enjoyable. . . . The physicists' work was widely seen as being culpable because it was applied to the taking of life; the first two atomic bombs did so on a vast and horrifying scale. But it was Pasteur, and not some atomic physicist, who in 1870 said of the Germans, 'I want to see the war prolonged into the depths of winter, so that all those vandals confronting us shall perish of cold and hunger and disease'."—ROBERT REID, *Microbes and Men*; p. 168. London: B.B.C. Publications. 1974. £2.50.

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